

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A modified annexin having an N-terminal chelation site, wherein the chelation site comprises an amino acid extension, the amino acid extension comprising a glycine and a cysteine residue.
2. The modified annexin of Claim 1 wherein the amino acid extension comprises the amino acid sequence X<sub>1</sub>-Gly-X<sub>2</sub>, wherein X<sub>1</sub> and X<sub>2</sub> are selected from Gly and Cys, and wherein at least one of X<sub>1</sub> or X<sub>2</sub> is Cys.
3. The modified annexin of Claim 1 wherein the amino acid extension comprises the amino acid sequence Gly-Gly-Cys.
4. The modified annexin of Claim 1 wherein the amino acid extension comprises the amino acid sequence Cys-Gly-Gly.
5. The modified annexin of Claim 1 wherein the amino acid extension comprises the amino acid sequence Cys-Gly-Cys.
6. The modified annexin of Claim 1 wherein the annexin is annexin V.
7. The modified annexin of Claim 1 wherein the amino acid at position 316 of the annexin is mutated to serine.
8. The modified annexin of Claim 1 wherein the modified annexin is recombinantly formed.
9. The modified annexin of Claim 1 further comprising a radionuclide complexed to the chelation site.
10. The modified annexin of Claim 7 wherein the radionuclide is selected from the group consisting of Cu-64, Cu-67, Ga-67, Ga-68, Re-186, Re-188, Tc-99m, Tc-94, Ru-95, Pd-100, Pd-109, Bi-212, Pb-212, and In-111.
11. The modified annexin of Claim 10 wherein the radionuclide is Tc-99m.

12. A modified annexin having the amino acid sequence set forth in SEQ ID NO:2.
13. The modified annexin of Claim 12 further comprising a complexed radionuclide.
14. The modified annexin of Claim 13 wherein the radionuclide is Tc-99m.
15. A modified annexin having the amino acid sequence set forth in SEQ ID NO:4.
16. The modified annexin of Claim 15 further comprising a complexed radionuclide.
17. The modified annexin of Claim 16 wherein the radionuclide is Tc-99m.
18. A modified annexin having the amino acid sequence set forth in SEQ ID NO:6.
19. The modified annexin of Claim 18 further comprising a complexed radionuclide.
20. The modified annexin of Claim 19 wherein the radionuclide is Tc-99m.
21. An isolated nucleic acid molecule encoding a modified annexin having an N-terminal chelation site, wherein the chelation site comprises an amino acid extension, the amino acid extension comprising a glycine and a cysteine residue.
22. An isolated nucleic acid molecule encoding a modified annexin having the amino acid sequence set forth in SEQ ID NO:2.
23. An isolated nucleic acid molecule encoding a modified annexin having the amino acid sequence set forth in SEQ ID NO:4.
24. An isolated nucleic acid molecule encoding a modified annexin having the amino acid sequence set forth in SEQ ID NO:6.
25. An isolated nucleic acid molecule having the nucleic acid sequence set forth in SEQ ID NO:1.

26. An isolated nucleic acid molecule having the nucleic acid sequence set forth in SEQ ID NO:3.

27. An isolated nucleic acid molecule having the nucleic acid sequence set forth in SEQ ID NO:5.

28. A replicable expression vector comprising a nucleic acid sequence encoding a modified annexin having an N-terminal chelation site comprising an amino acid sequence X<sub>1</sub>-Gly-X<sub>2</sub>, wherein X<sub>1</sub> and X<sub>2</sub> are selected from Gly and Cys, and wherein at least one of X<sub>1</sub> or X<sub>2</sub> is Cys.

29. A replication expression vector of Claim 28 comprising a nucleic acid sequence encoding a modified annexin having the amino acid sequence set forth in SEQ ID NO:2.

30. A replication expression vector of Claim 28 comprising a nucleic acid sequence encoding a modified annexin having the amino acid sequence set forth in SEQ ID NO:4.

31. A replication expression vector of Claim 28 comprising a nucleic acid sequence encoding a modified annexin having the amino acid sequence set forth in SEQ ID NO:6.

32. A host cell comprising a vector of Claim 28.

33. A host cell comprising a vector of Claim 29.

34. A host cell comprising a vector of Claim 30.

35. A host cell comprising a vector of Claim 31.

36. An isolated nucleic acid molecule that is capable of hybridizing to the nucleic acid sequence set forth in SEQ ID NO:1, or to the complementary sequence of the nucleic acid molecule set forth in SEQ ID NO:1, under stringent hybridization conditions.

37. An isolated nucleic acid molecule that is capable of hybridizing to the nucleic acid sequence set forth in SEQ ID NO:3, or to the complementary sequence

of the nucleic acid molecule set forth in SEQ ID NO:3, under stringent hybridization conditions.

38. An isolated nucleic acid molecule that is capable of hybridizing to the nucleic acid sequence set forth in SEQ ID NO:5, or to the complementary sequence of the nucleic acid molecule set forth in SEQ ID NO:5, under stringent hybridization conditions.

39. A chelation moiety comprising the amino acid sequence X<sub>1</sub>-Gly-X<sub>2</sub>, wherein X<sub>1</sub> and X<sub>2</sub> are selected from Gly and Cys, and wherein at least one of X<sub>1</sub> or X<sub>2</sub> is Cys.

40. A chelation moiety comprising the amino acid sequence Gly-Gly-Cys.

41. A chelation moiety comprising the amino acid sequence Cys-Gly-Gly.

42. A chelation moiety comprising the amino acid sequence Cys-Gly-Cys.

43. A modified protein having a chelation site comprising the amino acid sequence X<sub>1</sub>-Gly-X<sub>2</sub>, wherein X<sub>1</sub> and X<sub>2</sub> are selected from Gly and Cys, and wherein at least one of X<sub>1</sub> or X<sub>2</sub> is Cys.

44. The modified protein of Claim 43 further comprising a radionuclide complexed to the chelation site.

45. The modified protein of Claim 43 wherein the chelation site comprises the amino acid sequence Gly-Gly-Cys.

46. The modified protein of Claim 45 further comprising a radionuclide complexed to the chelation site.

47. The modified protein of Claim 43 wherein the chelation site comprises the amino acid sequence Cys-Gly-Gly.

48. The modified protein of Claim 47 further comprising a radionuclide complexed to the chelation site.

49. The modified protein of Claim 43 wherein the chelation site comprises the amino acid sequence Cys-Gly-Cys.

50. The modified protein of Claim 49 further comprising a radionuclide complexed to the chelation site.

51. A method for imaging vascular thrombi comprising  
administering to a warm-blooded animal an effective amount a modified annexin having an N-terminal chelation site, wherein the chelation site comprises an amino acid extension, the amino acid extension comprising a glycine and a cysteine residue, and wherein a radionuclide is complexed to the chelation site; and  
obtaining nuclear images of the animal to determine the presence and location of vascular thrombi.

52. The method of Claim 51 wherein the amino acid extension comprises the amino acid sequence X<sub>1</sub>-Gly-X<sub>2</sub>, wherein X<sub>1</sub> and X<sub>2</sub> are selected from Gly and Cys, and wherein at least one of X<sub>1</sub> or X<sub>2</sub> is Cys.

53. The method of Claim 51 wherein the amino acid extension comprises the amino acid sequence Gly-Gly-Cys.

54. The method of Claim 51 wherein the amino acid extension comprises the amino acid sequence Cys-Gly-Gly.

55. The method of Claim 51 wherein the amino acid extension comprises the amino acid sequence Cys-Gly-Cys.

56. A method for imaging apoptosis comprising  
administering to a warm-blooded animal an effective amount a modified annexin having an N-terminal chelation site, wherein the chelation site comprises an amino acid extension, the amino acid extension comprising a glycine and a cysteine residue, and wherein a radionuclide is complexed to the chelation site; and  
obtaining nuclear images of the animal to determine the presence and location of apoptotic cells.

57. The method of Claim 56 wherein the amino acid extension comprises the amino acid sequence X<sub>1</sub>-Gly-X<sub>2</sub>, wherein X<sub>1</sub> and X<sub>2</sub> are selected from Gly and Cys, and wherein at least one of X<sub>1</sub> or X<sub>2</sub> is Cys.

58. The method of Claim 56 wherein the amino acid extension comprises the amino acid sequence Gly-Gly-Cys.

59. The method of Claim 56 wherein the amino acid extension comprises the amino acid sequence Cys-Gly-Gly.

60. The method of Claim 56 wherein the amino acid extension comprises the amino acid sequence Cys-Gly-Cys.

61. The method of Claim 56 wherein the apoptosis is associated with rejection as a result of transplantation.

62. The method of Claim 56 wherein the apoptosis is associated with response to a chemotherapeutic agent.

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